

The Effect of a Contract on Patient Compliance in an Auditory Training Program

Capstone

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Abstract

The purpose of the present study was to assess the effect of a signed contract on patient compliance rates with the Listening and Communication Enhancement (LACE) aural rehabilitation program. A secondary purpose of this study was to assess subjective and objective treatment outcomes of the LACE program related to patient compliance rates. Twenty older adults with bilateral sensorineural hearing loss and who are users of binaural hearing aids were randomly placed into either the no contract (i.e., control) group or the contract (i.e., experimental) group, with the experimental group signing a contract before beginning the LACE program, and the control group beginning the LACE program without signing a contract. While implementation of a signed contract did not demonstrate a significant increase in compliance rates when compared to the no contract group, it appeared to encourage subject completion of at least half of the LACE program. There were no significant differences present between outcome measure data from pre-treatment to post-treatment in the present study, however, many subjects had little room for improvement, as their baseline measures were good to begin with. Future research should consider determining compliance criteria of the LACE on an individual basis, and using more difficult outcome measures such as the SPIN test. Creation of additional methods that establish the patient as a decision-making partner in therapy and subsequently develop individualized patient motivation to complete recommended training in aural rehabilitation programs should also be considered.

Dedication

This project is dedicated to my amazing family – specifically to my husband, Ben, for his unwavering support, and to my parents for encouraging me to pursue my passion.

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Chapter 1: Introduction and Literature Review

Sensorineural Hearing Loss & Speech Understanding in the Aging Population

Many health issues among the aging population have associated quality of life implications, including sensorineural hearing loss. Dalton et al. (2003) demonstrated that older adults with moderate to severe hearing loss were almost eight times more likely than older adults without hearing loss to report difficulties with communication that subsequently affect vitality, social functioning, mental health, and physical functioning. Identification of older adults with hearing loss and provision of appropriate treatment is therefore an essential factor in improving quality of life for these individuals.

Hearing loss is one of the most common chronic health problems among older adults, as approximately one out of three individuals over the age of 60 has hearing loss (Liu & Yan, 2007; NIDCD, 2012). Age-related hearing loss, or presbycusis, is influenced by genetic and environmental factors (Liu & Yan, 2007). While presbycusis does appear to cluster within families, environmental factors are influential on the variability of presbycusis with increasing age (Liu & Yan, 2007). Environmental risk factors that may increase susceptibility to presbycusis include noise exposure, ototoxic substances, cigarette smoking, and elevated blood pressure and cholesterol levels (Liu & Yan, 2007).

For many older individuals, increasing age and a history of environmental risk factors result in the presence of a bilateral sloping sensorineural hearing loss, greatest in the high frequencies. Hearing loss, with limited audibility of high-frequency acoustic cues, results in difficulty understanding speech at conversational levels. Difficulty understanding speech for individuals with hearing loss is magnified when high levels of

noise and reverberation are present in a listening space, as speech can be difficult to hear over high levels of background noise or distorted by especially reverberant environments (Gordon-Salant, 2005). Older adults also often experience cognitive decline as part of the advanced aging process, including a generalized slowing of perceptual processing (Gordon-Salant, 2005). Ball et al. (2002) report that approximately 50% of American adults aged 60 years and older express concern regarding declining mental abilities. The slowing of perceptual processing experienced by older adults may also affect working memory capacity, as these individuals lose the ability to prevent distracting stimuli from affecting attention, memory, and processing (Gordon-Salant, 2005). Distracting stimuli such as background noise or reverberation, therefore, can make speech understanding very difficult for individuals who not only have a bilateral sloping sensorineural hearing loss, but are also experiencing the effects of cognitive decline due to advanced aging.

Helfer and Wilber (1990) examined the effect of noise and reverberation on speech perception in younger and older adults with sloping sensorineural hearing loss as well as younger and older adults with normal hearing or minimal hearing loss. Nonsense syllables were presented under various listening conditions, including four increasing levels of reverberation from 0.0-1.3 seconds in both quiet and cafeteria noise at a +10 signal-to-noise ratio (SNR). Results from the Helfer and Wilber study revealed a strong negative correlation between increasing age and decreasing speech understanding performance in reverberation plus noise, even for older adults with only minimal hearing loss. Differences in performance of speech understanding between young adults and older adults demonstrated in reverberation and noise levels that are typical for real-world listening spaces suggest that factors other than peripheral hearing loss may contribute to

poor speech perception in adverse listening conditions for the aging population, such as cognitive decline and subsequent reductions in working memory.

Murphy, Craik, Li, and Schneider (2000) examined the effects of aging and background noise on short-term memory performance in a series of five experiments. Patterns of memory loss observed in older adults were reproduced by degrading the auditory stimulus of sentences with background babble presented at an SNR level at which older adults could correctly identify 50% of low-context words, and the sentences were presented to 15 young adults with normal hearing. Results revealed that for the ability to remember a spoken word, young adults performed better than older adults in quiet, young adults listening in speech babble background noise performed similarly to older adults listening in quiet, and young adults performed better than older adults when a SNR was used in each group that hypothetically made understanding speech in noise equally difficult across groups (Murphy et al., 2000). The results from the Murphy et al. study suggest that short-term memory may be impaired in older adults due to a degraded auditory system, such as a bilateral sloping sensorineural hearing loss, and a reduction in available processing resources, cognitive decline. The results from the Murphy et al. study also indicate that short-term memory impairment may contribute to poor performance in speech understanding, especially in noise, in the aging population.

The ability to repeat the last three words heard in a string of five to 15 words was examined by McCoy et al. (2005) among older adults with normal to near-normal hearing and older adults with mild to moderate hearing loss. Results suggest that performance in memory recall of the final three words heard in a sentence was negatively affected by the presence of mild to moderate hearing loss, due to added perceptual effort required for

successful word recognition. The McCoy et al. study also suggested that difficulty understanding speech due to the presence of a hearing loss may result in an overestimation of the amount of cognitive decline in this population, especially for older adults with more significant hearing loss. The presence of sensorineural hearing loss in the aging population negatively affects speech understanding, especially in difficult listening environments, and also negatively affects memory recall of words, subsequently making effective communication very challenging for this population.

Aural Rehabilitation

Aural rehabilitation was born out of services provided to veterans who developed hearing loss during World War II, and currently typically includes hearing aid fitting and orientation, educational and informational counseling, and auditory training. Comprehensive audiological evaluations, individual and group therapy, classroom instruction, and consistent hearing aid evaluations and fittings for World War II veterans at several Army and Navy hospitals were actually the first organized aural rehabilitation programs in the United States. Providers of aural rehabilitation services to World War II veterans included acoustic technicians, auditory training instructors, lip-reading instructors, speech-correctionists, psychologists, social workers, occupational therapists, and educational and vocational counselors. Therapy sessions and classroom instruction focused on speechreading, memory exercises, and auditory training. Veterans who took part in these early programs were treated at a military hospital, where they also lived, and participated in a full-time aural rehabilitation course that lasted approximately eight weeks. From these early beginnings of the profession of audiology, two distinct roles of audiologists emerged, including that of diagnostician as well as direct provider of

treatment and rehabilitation services to individuals with hearing loss. While the field of audiology has greatly grown and developed in diagnostics, aural rehabilitation is not consistently incorporated into standard audiological protocols (Ross, 1997).

The term “auditory training” has represented multiple facets of aural rehabilitation throughout the development of the profession of audiology. According to Blamey and Alcantara (1994), before wearable electronic hearing aids were readily available, the terms “aural rehabilitation” and “auditory training” were almost synonymous. The first electronic hearing aids were actually referred to as “auditory trainers,” as they were not wearable and subsequently used for training sessions only. Now, in the modern days of readily available and wearable hearing aids, the role of auditory training has shifted into a smaller part of the entire aural rehabilitation process. Therefore, while the term “aural rehabilitation” represents the global process of rehabilitating the auditory system, Blamey and Alcantara (1994) describe the term “auditory training” as representing the use of instruction, drill, or practice to increase perception of auditory information.

Boothroyd (2007) stated that aural rehabilitation consists of sensory management, instruction, perceptual training, and counseling, and that this combination of treatment helps to improve auditory function, activity, participation, and quality of life. However, aural rehabilitation provided by an audiologist is not covered by third-party payers, and individuals are often unwilling to pay for this treatment out-of-pocket. Therefore, there is a need for both the effectiveness and the efficiency of aural rehabilitation to be demonstrated (Boothroyd, 2007).

Burk and Humes (2008) examined the effects of aural rehabilitation on speech recognition performance by administering a long-term auditory training protocol to eight

older adults with hearing loss. Preliminary practice sessions established a suitable SNR for each participant by measuring recognition performance of open-set lexically easy and lexically hard words at an SNR of 0 dB and open-set sentences with keywords of medium lexical difficulty at an SNR of -2 dB (Burk & Humes, 2008). Participants with a practice word recognition performance score of less than 25% were given an SNR of +3 dB for word recognition measures and an SNR of +1 dB for sentence recognition measures for the remainder of the study (Burk & Humes, 2008). Baseline measures were taken with open- and closed-set lexically easy and lexically hard words, as well as open-set lexically easy and lexically hard sentences. The lexical difficulty level of words and sentences in this study were based on the neighborhood activation model of speech perception (Luce & Pisoni, 1998). Training sessions were administered on a computer using lexically hard words in a closed-set condition. Both orthographic and auditory feedback was given for incorrect answers, followed by a midpoint evaluation and additional training sessions with lexically easy words (Burk & Humes, 2008). Post-training measures revealed that speech recognition performance improved with trained materials, and listeners were able to maintain these improvements over an extended period of time (Burk & Humes, 2008).

Humes, Burk, Strauser, and Kinney (2009) continued to study of the effects of aural rehabilitation on speech recognition in older adults with hearing loss by designing a word-based auditory training procedure that included stimuli with a high frequency of occurrence in American English. Stimuli consisted of lexically difficult words, lexically easy words, and phrases recorded by four different speakers, while post-training evaluation of study participants consisted of recognition of sentences recorded by novel speakers (Humes et al., 2009). Approximately 75% of the older adults with hearing loss

included in the Humes et al. study showed significant improvement in recognition of novel sentences recorded by novel speakers following auditory training of frequently occurring words and phrases. Training stimuli consisted of a much larger set of training materials than stimuli included in the Burk and Humes (2008) study, in order to represent approximately 80-90% of words most frequently used in spoken conversation. Results suggest that using a larger and more variable set of trained stimuli may result in generalization of trained words to novel sentences and speakers.

Northern and Beyer (1999) reported that administration of the Hearing Education and Listening Program (H.E.L.P.) resulted in fewer hearing aid returns. Patients who took part in this series of 3 one-hour classes were observed to be more likely to keep their hearing aids and to achieve optimal aided performance than patients who chose not to participate in the program (Northern & Beyer, 1999). This aural rehabilitation program focused on aspects of hearing loss, communication strategies, care and use of hearing aids, assistive listening devices, and realistic expectations (Northern & Beyer, 1999). It was suggested that this decrease in hearing aid return rate may be indicative of greater user satisfaction due to aural rehabilitation (Northern & Beyer, 1999). Sweetow, Corti, Edwards, Moodie, and Henderson-Sabes (2007) recommend that aural rehabilitation be an integral part of standard audiological protocol, rather than an add-on option, as administration of aural rehabilitation at the initial hearing aid fitting has been shown to yield greater patient aided performance in speech understanding tasks and greater patient satisfaction (Northern & Beyer, 1999; Burk & Humes, 2008; Humes et al., 2009).

Sweetow and Palmer (2005) suggest that there is a need for aural rehabilitation programs that are time- and cost-effective for both the patient and the audiologist. A

systematic review revealed that auditory training can produce communication improvements in the older adult hearing impaired population, as neural plasticity is not lost with age. Sweetow and Palmer also recommended that aural rehabilitation programs utilize both analytic, or bottom up, training which focuses on the identification of speech sounds (i.e., consonant recognition), and synthetic, or top down, training that focuses on comprehension of speech (i.e., communication strategies). Efficient strategies that have been suggested for implementation of aural rehabilitation include bundling basic instruction and counseling into the cost of an amplification device, group aural rehabilitation, and computer-based auditory training programs (Boothroyd, 2007; Sweetow & Palmer, 2005).

Computer-based Aural Rehabilitation Programs

Use of computerized aural rehabilitation programs has been repeatedly demonstrated as an effective and efficient way of improving communication for all ages of the hearing impaired population (Osberger, Lippmann, Moeller, & Krose, 1981; Tye-Murray, Witt, Schum, Kelsay, & Schum, 1994; Bloom, 2004; Martin, 2007). In 1981, Osberger et al. developed a speech-training program for children with hearing loss that was administered with a small computer and analog analysis equipment. This program was developed to supplement one-on-one training with a teacher, as working on repetitive speech drills in this manner was shown to be effective as well as time-efficient (Osberger et al., 1981). Use of computer software for home-based auditory training was recommended for children with cochlear-implants (Tye-Murray et al., 1994). Use of this program is reported to be most successful when combined with appropriate orientation conducted by an audiologist, some form of accountability for consistent use, and frequent

contact from an audiologist throughout home use of the program (Tye-Murray et al., 1994). Bloom (2004) suggested that the success seen with children from use of computer-based aural rehabilitation programs could be translated to older adults with hearing loss. Home computers have become commonplace and older adults have subsequently become more computer savvy (Mayhorn, Stronge, McLaughlin, & Rogers, 2004). Home computer-based auditory training programs are more readily available and have evidence demonstrating their effectiveness (Bloom, 2004). Programs like Kraus' Brainvolts, Musiek's Dichotic Interaural Intensity Difference training, Parker's MacAid, and Sweetow and Henderson-Sabes' Listening and Communication Enhancement (LACE) program are time-efficient and cost-effective ways to provide aural rehabilitation to older adults who may be having difficulty understanding speech in noisy environments, even with use of their amplification systems (Bloom, 2004). Unlike other aural rehabilitation programs, the LACE program utilizes auditory training tasks that address not only speech understanding in noise, but also comprehension of rapid speech, auditory memory, and use of context clues (Martin, 2007). Martin (2007) examined the effectiveness of the LACE program in reducing hearing aid return rates. Results revealed that patients who did not use LACE were approximately four times more likely to return their hearing aids than patients who did use LACE (Martin, 2007). Creation of the LACE program made an at-home computer-based aural rehabilitation program available that was both efficient and effective, not only in patient outcome measures but also in hearing aid return rates (Martin, 2007).

The Listening and Communication Enhancement Program (LACE)

The initial pilot study for the LACE program was administered in 2004 by Sweetow and Henderson-Sabes. Development of the LACE program was guided by the assumptions that individuals with hearing impairment can use home computer-based auditory training to acquire skills and strategies for better understanding of speech in noise, and that this training is most effective when it is individualized for each patient (Sweetow & Henderson-Sabes, 2004). The LACE program is designed to combine the enhancement of listening skills with development of communication strategies, allowing for a positive feedback loop to occur within Kiessling et al.'s (2003) elements of communication (Sweetow & Henderson-Sabes, 2004). Kiessling et al. (2003) suggest that the four steps of hearing, listening, comprehension, and communication, when acquired in order, will lead to effective communication. Improvements in performance of any one of these four steps will result in improvements in the other steps as well, creating a positive feedback loop, while breakdowns in any one of these four steps will result in a negative feedback loop that also affects the other steps (Sweetow & Henderson-Sabes, 2004). While the sample size used in the LACE pilot study was too small to perform definitive statistical analysis, results revealed that practice of auditory training exercises with immediate feedback for 30 minutes a day, five days a week, over the course of four weeks improved performance in all speech understanding in noise tests administered in three out of four subjects (Sweetow & Henderson-Sabes, 2004).

Additional development of LACE and a continuation of the program's initial pilot study were conducted in 2006 by Sweetow and Henderson-Sabes. Several main objectives of the LACE program, in addition to the enhancement of listening and communication skills, guided its development, including patient motivation, increased

satisfaction with hearing aids, and realistic expectations. LACE was designed to include extensive amounts of patient involvement, encouraging the patient to experience a role of responsibility within the program that would hopefully result in increased confidence in communication as improvements in training were achieved. Increased confidence in communication from use of the program may increase patient satisfaction with hearing aids, and patient satisfaction may also be positively impacted by informational counseling provided within the program that will encourage realistic patient expectations. Further development of the LACE program following its initial pilot study included the following factors as essential parts of the program: the program must be cost-effective, practical, easily accessible, interactive, individualized, and incorporate both bottom-up and top-down training. The level of difficulty for each task presented in LACE is individualized to the user, in that it is determined by the accuracy of the response to the previous trial (Sweetow & Henderson-Sabes, 2006).

The specific training exercises that were chosen for LACE include speech in babble, time compressed speech, competing speaker, target word, and missing word, as well as various presentation of interactive communication strategies. These training exercises were chosen based on accessibility, ease of use, and feedback from subjects in the LACE pilot study. The training in LACE is designed to encourage the listener to utilize contextual cues throughout the entire program by selecting stimuli topics that are interesting to him or her at the beginning of the training session. The speech in babble exercise begins with an SNR of +10 dB, which increases or decreases by a 4 dB step size for the first five sentences followed by a 2 dB step size adjustment for the remaining sentences, depending on the listener's performance. The time compressed speech

exercise modifies the compression ratio of the speech signal, and begins at a compressed ratio of 85%. The compression ratio increases or decreases by 0.075% for the first five sentences, followed by an adjustment of 0.025% for the remaining sentences, also depending on the listener's performance. The competing speaker exercise is exactly the same as the speech in babble exercise, with the exception of a single talker in the background rather than a multitalker babble background. Together, the speech in babble, time compressed speech, and competing speaker exercises complete the degraded and competing speech training portion of the LACE, which constitutes 70% of the entire program. The target word task is an auditory working memory training exercise in which the listener is provided with a target word in a sentence and must select what word came just before the target word. Difficulty levels in this task are adjusted according to when the target word is presented, the length of the sentence, and the number of sentences, depending on the listener's performance. The missing word task is a speed of processing and utilization of linguistic and contextual cues training exercise in which one word of a sentence is masked out by an environmental sound. The listener must select the most appropriate word that would complete the presented sentence from a list of four options as quickly as possible. While this task is not adaptive to the listener's performance level, the program will provide feedback for incorrect answers and keep track of the amount of correct answers and average response time. The target word and missing word tasks complete the cognitive training portion of the LACE, and together constitute 30% of the entire program. The LACE program also presents interactive communication strategies throughout the program that provide recommendations concerning management of the acoustical environment, care and maintenance of hearing aids, assistive listening devices,

and realistic expectations, among additional tips and hints (Sweetow & Henderson-Sabes, 2006).

Sweetow and Henderson-Sabes (2006) studied verification of the LACE program with the addition of the adaptive levels of difficulty, cognitive training exercises, and interactive communication strategies to the original pilot study version. Significant improvements in performance were measured in all of the training exercises as the program progressed. These improvements were a reflection of perceptual learning rather than procedural learning as additional improvements were measured beyond the first week of training. Significant improvements in performance on off-task outcome measures were also revealed in both objective and subjective measures from baseline to post-training. While great improvements in listening abilities were seen with the use of LACE in this study, over 20% of the subject population that were initially enrolled did not complete the training protocol. A 20% drop-out rate clearly demonstrates that patient motivation, willingness, and compliance will play key roles in allowing individuals who use LACE reach their full potential in listening performance (Sweetow & Henderson-Sabes, 2006).

Importance of Compliance in Treatment

Establishing compliance is an essential factor to patient success, not only for individuals taking part in aural rehabilitation programs, but also for patients that take part in any health care service for prevention or treatment. Patient noncompliance can increase the demand and overall cost of health care services. Although health care providers inform patients of the consequences of noncompliance to medical recommendations, encouragement of patient compliance must be done in an ethical

manner. A three-phase process is recommended to promote patient compliance in an ethical, rather than threatening, pressure-filled, or fear-inducing manner, including the establishment of a plan and specification of self-care behaviors, followed by development of patient competency, and finally support and reinforcement of self-care (Connelly, 1984).

Many specific strategies to promote compliance are recommended from experts across various health care professions, and they are often focused on soliciting patient education and patient motivation. Olthoff, Schouten, van de Borne, and Webers (2005) described the need for an educational prevention program for patients with glaucoma to improve patient compliance, as enhanced patient knowledge and understanding of the disease may increase adherence to recommendations for prevention or treatment of glaucoma. So et al. (2003) examined whether enhanced patient education would increase compliance to specific treatments for burns, and found that detailed multimedia patient education resulted in significant improvements in both compliance to treatment and burn scar outcome when compared to administration of only conventional patient education. Haynes, McDonald, and Garg (2002) provide an alternate point of view, and suggested that patient compliance may be improved when the recommended treatment regimen is kept as simple and easy to understand as possible. Campbell et al. (2001) examined compliance of patients in physiotherapy with osteoarthritis of the knee, and recommended that health care providers go beyond providing enhanced patient education regarding their specific illness and treatment, and view the patient as a decision-making partner in therapy. This patient-provider team approach to treatment is known as

concordance, and is recommended as a key factor in solicitation of patient compliance to treatment (Campbell et al., 2001).

Marvel, Epstein, Flowers, and Beckman (1999) reported that physicians often redirect patients during case history gathering before all relevant information is obtained. This may result in missed opportunities with the patient, including appropriate treatment recommendations and a positive patient-provider rapport (Marvel et al., 1999). Soliciting the patient's agenda allows concordance to occur, which in turn may increase patient compliance once treatment is recommended (Marvel et al., 1999). Robinson (1987) described the importance of sociocultural awareness in patient compliance to occupational therapy regimens, and recommended that treatment plans be adjusted to each individual patient's cognitive and cultural values to increase patient motivation. Gearing treatment toward the patient's values allows the health care provider to align what is important for success in treatment with what is important to the patient, subsequently encouraging compliance (Cameron, 1996; Robinson, 1987). Increasing follow-up with patients is also a recommendation to improve adherence to treatment, as multidisciplinary treatment and close follow-up is suggested to increase compliance among patients with retinoblastoma (Bakhshi, Gupta, Gogia, & Ravindranath, 2010). Consistently scheduling definite follow-up appointments was also a characteristic of physicians with the highest patient compliance rates, and was believed to influence adherence to treatment for diabetes, hypertension, and heart disease (DiMatteo et al., 1993). Pawar (2005) provides a five-step process for health care providers, which was inspired by the business world and incorporates many of these recommendations for improvement in patient compliance rates to treatment. Pawar (2005) suggests an

establishment of trust between patient and provider, discovery of actual patient needs, solicitation of dialogue between patient and provider rather than a provider monologue, recommendation of treatment in an encouraging, rather than forceful, manner, and close follow-up.

Bloom (2004) and Kochkin et al. (2010) reported that less than 10% of audiologists actually offer auditory training to their patients, despite the evidence that auditory training improves listening performance and increases satisfaction with hearing aids, subsequently reducing hearing aid return rates (Northern & Beyer, 1999; Martin, 2007; Burk & Humes, 2008; Humes et al., 2009). Additionally, among this small percentage of patients to whom auditory training is recommended, many of the patients do not actually complete their training and therefore do not reach their full potential in listening performance and hearing aid satisfaction (Sweetow & Henderson-Sabes, 2010). Compliance rates for over 3,000 LACE users were found to be less than 30% when compliance was deemed as completing at least ten of the 20 training sessions included in the LACE program (Sweetow, 2009). Recommendations that are specific to increasing compliance with the LACE program include providing LACE as an integral and mandatory part of the initial hearing aid fitting, rather than an add-on, and utilizing the automated e-mail service provided to audiologists who offer LACE to their patients that sends a welcome message to the LACE trainee, encouraging messages as training sessions are completed, as well as reminders to begin or continue training if the patient has been inactive for a period of time (Sweetow, 2008). Kingham (2010) explored the effect of a signed contract on compliance rates for patients using the LACE program, and found that 50% of the patients who filled out and signed a commitment form completed

all 20 training sessions. Kingham (2010) suggested that implementation of the contract made the expectations of the audiologist clear while also allowing the patient to accept partial responsibility of the improvement of their listening abilities. The purpose of the present study, therefore, was to assess the effect of a signed contract on patient compliance rates with the LACE program. A secondary purpose of this study was to assess subjective and objective treatment outcomes of the LACE program related to patient compliance rates. It was hypothesized that subjects that sign a contract committing to full completion of the LACE program will have a higher patient compliance rate, and subsequently greater improvement in subjective and objective treatment outcomes, in comparison to subjects that do not sign a commitment form.

Chapter 2: Methods

Subjects

Twenty subjects were recruited through the patient database at the Ohio State University Speech-Language and Hearing Clinic in Columbus, Ohio. All subjects were older adults with documented bilateral sensorineural hearing loss, and included 13 males and seven females ranging from 65-80 years of age (mean = 72.2 years). Additional subject characteristics are listed in Table 1. Individuals over 80 years of age were not included in this study in order to limit confounding variables associated with age-related severe cognitive decline (i.e., dementia). Additional inclusion criteria for the present study included that subjects must be binaural hearing aid users with at least 1 year of experience with amplification. New hearing aid users were not included in this study in order to avoid possible lack of acclimatization effects. All subjects were compensated for their time, and took part in an initial, pre-treatment session as well as a post-treatment session. At the initial session, subjects signed a consent form and completed the pre-treatment HHIE. Otoscopy was administered bilaterally with an otoscope (Welch Allyn 71050-C), tympanometry was administered bilaterally via a middle ear analyzer (GSI TympStar), and unaided audiometry was administered bilaterally through a two-channel audiometer (Grason Stadler, Model 61) at the initial session as well. Pure tone air conduction thresholds were measured from 250-8000 Hz through insert earphones

(EARTone 3A) and pure tone bone conduction thresholds were measured through a bone oscillator

Table 1. Subject characteristics including gender, age (in years), ear specific pure tone average (PTA; in dB HL), and hearing aid experiences (in years).

Subject Number	Gender	Age	PTA - R	PTA - L	Hearing Aid Experience
CONTRACT					
1	male	79	50	57	5.5
3	male	77	48	58	4.5
5	female	76	60	53	12.58
7	female	71	48	52	2
9	male	76	20	22	8.5
11	male	65	28	33	5
13	male	66	40	28	1.42
15	male	77	43	8	2.83
17	male	71	25	23	1.83
19	female	72	50	42	4.92
Mean		73	41.2	37.6	4.91
Std. Deviation		4.81	12.87	17.33	3.44
NON-CONTRACT					
2	female	71	63	62	30.08
4	female	72	42	43	12.17
6	female	70	40	48	3.25
8	male	72	45	48	2.33
10	male	71	48	47	6.75
12	male	74	43	52	1.5
14	male	73	53	48	5.83
16	male	70	35	45	3.75
18	male	70	55	52	15.58
20	female	71	35	32	3.42
Mean		71.4	45.9	47.7	8.47
Std. Deviation		1.35	8.99	7.59	8.83

(Radioear B-71) from 250-4000 Hz. Subjects were tested in a sound-attenuating booth, and both the audiometer and tympanometer were calibrated according to the appropriate American National Standards Institute standards (ANSI, 1987, 2004).

Materials

Subjective assessment materials consisted of administration of the Hearing Handicap Inventory for the Elderly (HHIE; Ventry & Weinstein, 1982). The HHIE was completed by each subject both pre- and post-treatment. The HHIE explores the effects of hearing impairment upon emotional and social factors in the lives of elderly individuals. The HHIE contains 25 items, 13 of which are focused on the emotional consequences of a hearing impairment, and 12 of which are focused on the social and situational consequences of a hearing impairment. The HHIE is designed specifically for use with the elderly population, and allows clinicians a means for quantification of hearing handicap for individuals within this population. The HHIE is scored by assigning point values to each item depending on the answer, with four points given for every “yes” answer, two points given for every “sometimes” answer, and zero points given for every “no” answer. Scores have a numerical range of 0-100, with a higher score indicating a more severe perceived hearing handicap (Ventry & Weinstein, 1982). Objective assessment materials consisted of administration of the Quick Speech in Noise test (QSIN; Killion, Niquette, Gudmundsen, Revit, & Banerjee, 2004). The QSIN was administered to each subject both pre- and post-treatment. The QSIN is designed to quickly estimate SNR loss in approximately one to two minutes, with easy administration, good face validity, and simplified scoring. The QSIN simulates real-world listening environments by presenting sentences in the presence of four-talker

babble. This test includes 12 comparable lists of six sentences each, with a presented SNR of 25 dB in the first sentence that reduces by 5 dB for each subsequent sentence until the SNR reaches 0 dB for the sixth sentence. The QSIN quantifies the specific SNR necessary for an individual to understand 50% of words in a sentence presented in noise, which is determined via an equation and subsequently placed into a degree of SNR loss ranging from normal to severe (Killion et al., 2004).

Procedures

Aided SNR loss was measured via the QSIN, with two sentence lists presented to each subject and the average SNR loss taken between the two performances. QSIN stimuli were presented from a CD player (Sony CE375) through the audiometer at 50 dB HL in the sound field via speakers for all subjects. All subjects utilized their own properly working binaural hearing instruments during administration of the QSIN. Subjects were also provided with LACE software, a short demonstration of the program, and clear instructions concerning downloading and use of the program at the initial session. Subjects were randomly placed into either the no contract (i.e., control) group or the contract (i.e., experimental) group, with the experimental group signing a contract before beginning the LACE program, and the control group beginning the LACE program without signing a contract. The LACE contract allowed the examiner and the subject to plan specific deadlines for reaching milestones within the LACE program together in order to encourage completion of the LACE program in approximately four to five weeks. The contract was signed by both the subject and the examiner as a commitment to complete all 20 LACE sessions according to their agreed-upon schedule. Compliance and performance in the LACE program were monitored for all subjects

throughout the study, and all subjects were sent emails throughout their participation to congratulate them for completing a number of sessions or to encourage progress in the program after a certain time of inactivity. Compliance rates were measured as the number of LACE sessions each subject completed out of 20 by their final post-treatment session with the examiner. Performance measures that were taken within the LACE program included scores from the Speech-In-Noise Training, Rapid Speech Test, Word Memory Training, and Competing Speaker Training. Each subject's final post-treatment session with the examiner was scheduled for approximately four to five weeks after the initial session. The post-treatment session included completion of the post-treatment HHIE and aided SNR loss measured with the QSIN. Similar to the initial session, two sentence lists from the QSIN were presented to each subject and the average SNR loss was taken between the two performances. An informal assessment of each subject's overall thoughts concerning his or her experience with the LACE program was also gathered through conversation with the author.

Chapter 3: Results

Statistical Analysis

Participant data was subjected to a series of 2-way repeated measures analysis of variance (ANOVA) tests, comparing pre- and post-treatment HHIE scores and QSIN thresholds for both the contract group and no contract group. No significant differences were measured in tests of within-subjects effects or in tests of between-subjects effects for both the HHIE pre- and post-treatment scores and the QSIN pre- and post-treatment thresholds. Subsequently, the data from the present study were treated as a descriptive study.

Descriptive Statistics

Compliance rates of LACE completion for both groups (contract and no contract) are presented in Figure 1. Compliance was defined for the present study as completing 20 out of 20 LACE training sessions in the allotted amount of time of approximately five weeks. As can be seen from Figure 1, 70% of subjects in the no contract group completed all 20 LACE training sessions, while 50% of subjects in the contract group completed all 20 LACE training sessions. The Sweetow (2009) criterion for compliance, however, was defined as completing at least ten out of 20 LACE training sessions. As can be seen from Figure 1, using the Sweetow (2009) criterion for compliance revealed that 70% of subjects in the no contract group completed at least ten LACE training

sessions, while 80% of subjects in the contract group completed at least ten LACE training sessions.

The number of LACE sessions completed as a function of group are presented as box plots in Figure 2. The box plots present the range of sessions completed by each group. Specifically, the thin black line represents the median and the thick yellow line represents the mean number of sessions completed. The 75th and 25th percentiles are represented by the upper and lower boxes, respectively, the 90th and 10th percentiles are represented by the whiskers, and the outliers are represented by the dots. As can be seen in Figure 2, the contract group demonstrated greater variability and a lower average number of LACE sessions completed. The average number of sessions completed by the no contract group of 16.3/20 was greater than the average number of sessions completed by the contract group of 14.2/20, when all individual subject data was included. Two subjects in the contract group, however, failed to complete more than four LACE sessions. By excluding Subject 15 and Subject 17 from the contract group (four and two sessions completed), the average number of completed LACE sessions rose from 14.2/20 to 17/20, comparable to the control group (16.3/20).

Individual subject data for the HHIE questionnaire are presented as a bivariate plot in Figure 3. Specifically, the pre-treatment HHIE scores (abscissa) were plotted as a function of the post-treatment HHIE scores (ordinate). HHIE scores below the diagonal line indicate greater hearing handicap prior to LACE treatment. HHIE scores above the diagonal line indicate greater hearing handicap after LACE treatment. Scores on the line indicate equal hearing handicap after LACE treatment. As can be seen from Figure 3, both the contract group and no contract group contained subjects that showed an

improvement in HHIE score following treatment as well as subjects that showed a worsening in HHIE score following treatment. The contract group included 60% of subjects that showed an improvement in HHIE scores from pre- to post-treatment, and 40% of subjects that showed a worsening in HHIE scores. The no contract group included 60% of subjects that showed an improvement in HHIE scores from pre- to post-treatment, 20% of subjects that showed a worsening in HHIE scores, and 20% of subjects that had no change in HHIE scores.

Individual subject data for the QSIN test are presented as a bivariate plot in Figure 4. Specifically, the pre-treatment QSIN thresholds (abscissa) were plotted as a function of the post-treatment QSIN thresholds (ordinate). QSIN thresholds below the diagonal line indicate greater SNR loss prior to LACE treatment. QSIN thresholds above the diagonal line indicate greater SNR loss after LACE treatment. Thresholds on the line indicate equal SNR loss after LACE treatment. As can be seen from Figure 4, both the contract group and no contract group contained subjects that showed an improvement in QSIN threshold following treatment as well as subjects that showed a worsening in QSIN threshold following treatment. The contract group included 60% of subjects that showed an improvement in QSIN threshold from pre- to post-treatment, and 40% of subjects that showed a worsening in QSIN threshold. The no contract group included 40% of subjects that showed an improvement in QSIN threshold from pre- to post-treatment, 50% of subjects that showed a worsening in QSIN threshold, and 10% of subjects that had no change in QSIN threshold.

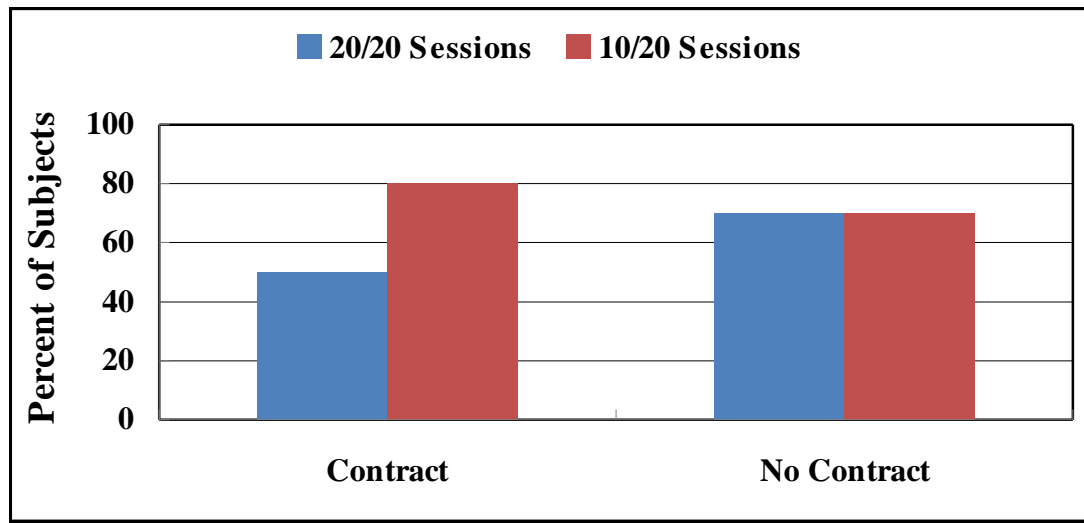


Figure 1. Subject compliance in percent [20 out of 20 LACE sessions in blue, ten out of 20 LACE sessions in red, re: Sweetow (2009)] across contract conditions: subjects who signed a contract stating that they would complete the program, and subjects who did not sign a contract.

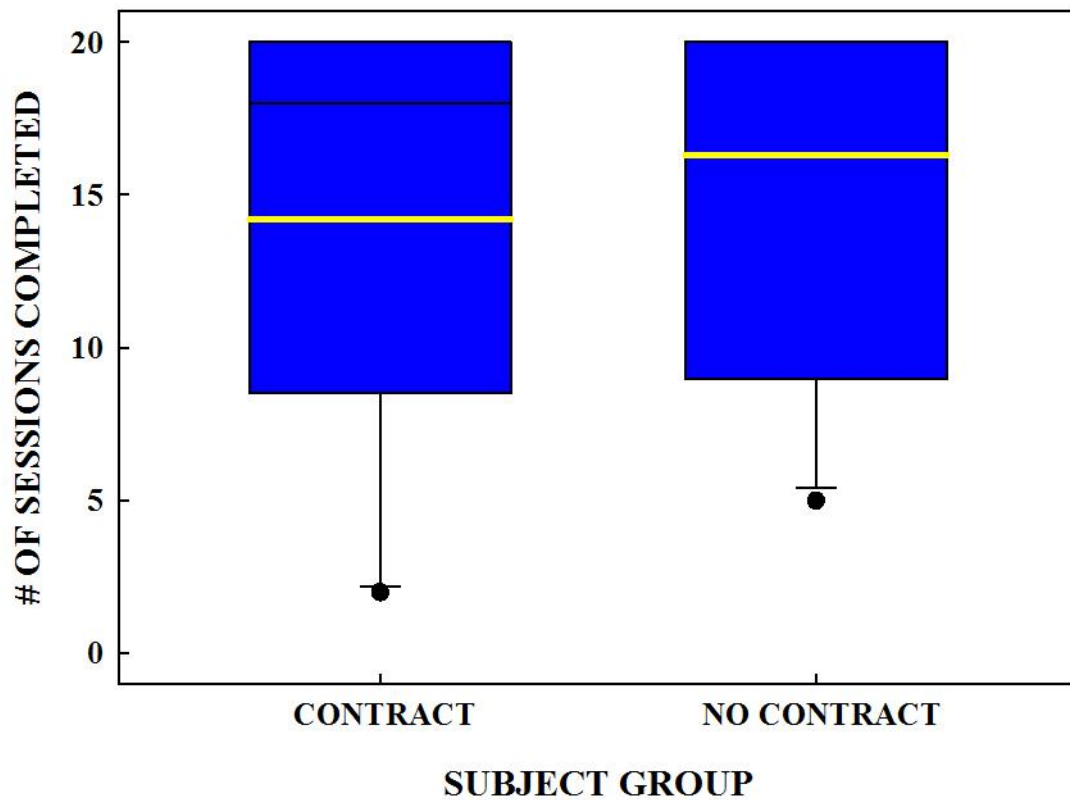


Figure 2. The number of LACE sessions completed as a function of group are presented as box plots. The box plots present the range of sessions completed by each group. The thin black line represents the median and the thick yellow line represents the mean number of sessions completed. The 75th and 25th percentiles are represented by the upper and lower boxes, respectively, the 90th and 10th percentiles are represented by the whiskers, and the outliers are represented by the dots.

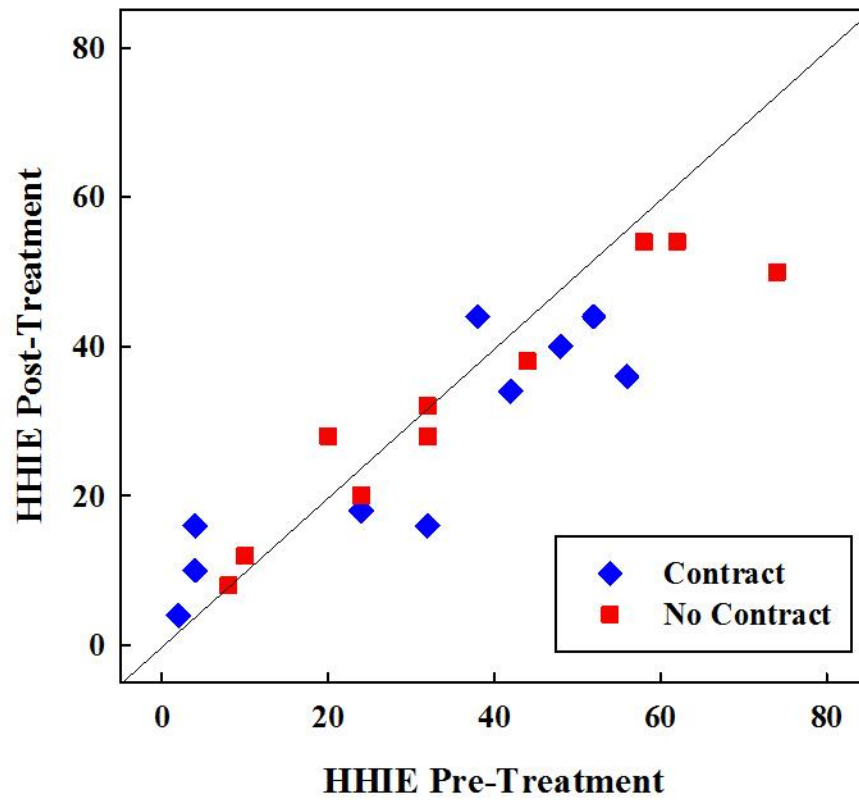


Figure 3. Bivariate plot of subject HHIE scores pre-treatment on the abscissa and HHIE scores post-treatment on the ordinate. Data points below the line indicate improvement in HHIE score from pre-treatment to post-treatment, and points above the line indicate a decrease in HHIE score from pre-treatment to post-treatment. Data points on the line indicate an equal score between pre-treatment and post-treatment.

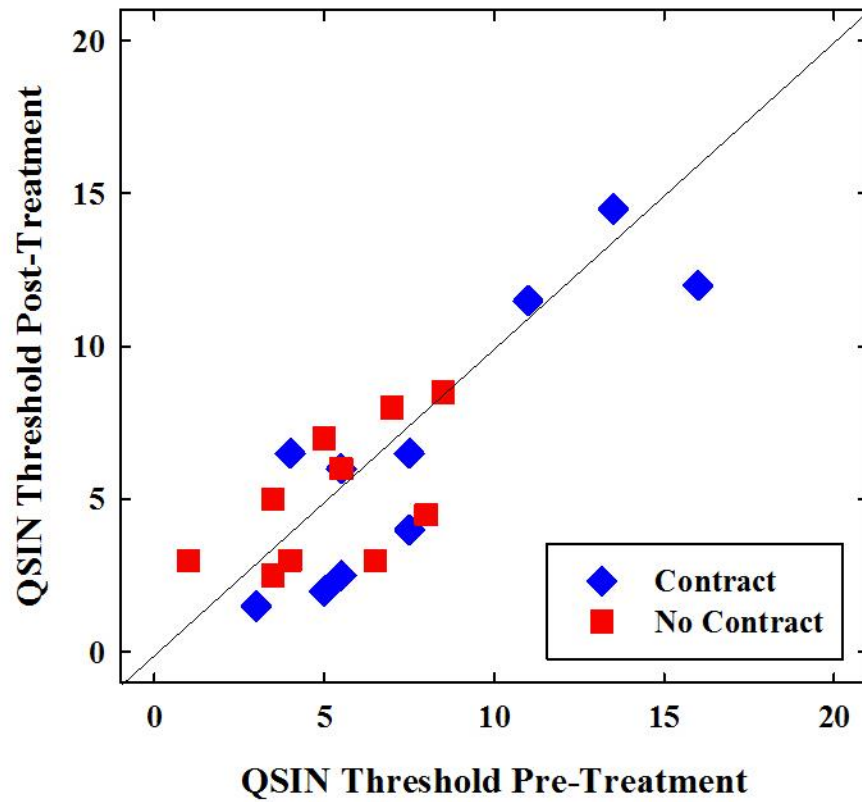
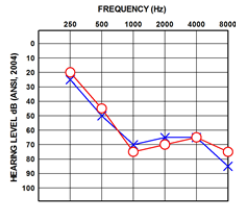


Figure 4. Bivariate plot of subject pre-treatment QSIN thresholds on the abscissa, and post-treatment QSIN thresholds on the ordinate. Data points below the line indicate improvement in QSIN threshold from pre-treatment to post-treatment, and points above the line indicate a decrease in QSIN threshold from pre-treatment to post-treatment. Data points on the line indicate an equal threshold between pre-treatment and post-treatment.

Figure 5 presents individual subject performance and demographic data of participants who were outliers in HHIE score (see Figure 3) and QSIN threshold (see Figure 4) differences from pre- to post-treatment in both the contract group and no contract group. As can be seen from Figure 5, these individual subjects displayed the largest improvements in HHIE scores and QSIN thresholds following LACE treatment. Participants of the present study who displayed the largest improvements in HHIE scores include Subject 4, Subject 15, and Subject 19. Of the participants with the largest improvements in HHIE scores, only Subject 4 was fully compliant with completion of the LACE. Subject 4 was also the only subject showing one of the largest improvements in HHIE score that had an amount of hearing aid experience over the overall study participant mean hearing aid experience level (6.7 years). Subject 15 demonstrated improvement from pre- to post-treatment in both HHIE score and QSIN threshold, while Subject 4 and Subject 19 demonstrated improvement from pre- to post-treatment only for HHIE score.

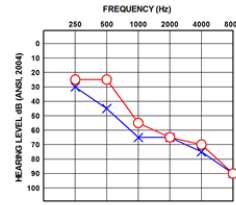
Participants of the present study who displayed the largest improvements in QSIN threshold from pre- to post-treatment include Subject 2, Subject 3, Subject 7, Subject 13, Subject 15, and Subject 16. All participants that demonstrated the largest improvements in QSIN threshold (see Figure 4) were fully compliant with completion of the LACE, with the exception of Subject 15. All of the subjects with the largest improvements in QSIN threshold had hearing aid experience levels that were below the overall study participant mean hearing aid experience amount (6.7 years), with the exception of Subject 2.

Subject 2



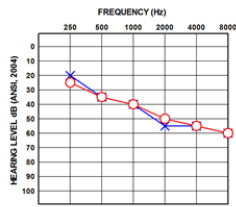
Group	Non-contract
Compliance	20 (sessions completed)
QSIN Difference	-3.5 (improvement in SNR loss)
HHIE Difference	-4 (improvement in score)
Hearing Aid Experience	30.08 (years)

Subject 3



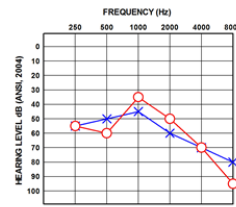
Group	Contract
Compliance	20 (sessions completed)
QSIN Difference	-4 (improvement in SNR loss)
HHIE Difference	-8 (improvement in score)
Hearing Aid Experience	4.5 (years)

Subject 4



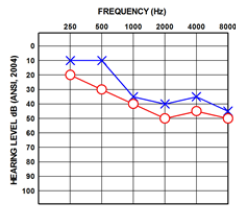
Group	Non-contract
Compliance	20 (sessions completed)
QSIN Difference	-1 (improvement in SNR loss)
HHIE Difference	-24 (improvement in score)
Hearing Aid Experience	12.17 (years)

Subject 7



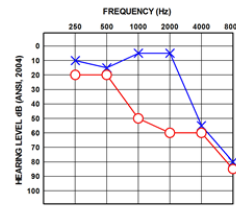
Group	Contract
Compliance	20 (sessions completed)
QSIN Difference	-3.5 (improvement in SNR loss)
HHIE Difference	-8 (improvement in score)
Hearing Aid Experience	2 (years)

Subject 13



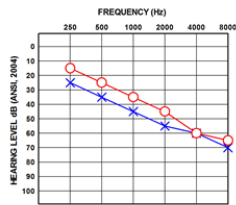
Group	Contract
Compliance	20 (sessions completed)
QSIN Difference	-3 (improvement in SNR loss)
HHIE Difference	+6 (worsening in score)
Hearing Aid Experience	1.42 (years)

Subject 15



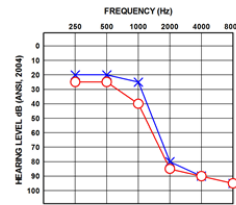
Group	Contract
Compliance	4 (sessions completed)
QSIN Difference	-3 (improvement in SNR loss)
HHIE Difference	-16 (improvement in score)
Hearing Aid Experience	2.83 (years)

Subject 16



Group	Non-contract
Compliance	20 (sessions completed)
QSIN Difference	-3.5 (improvement in SNR loss)
HHIE Difference	0 (no difference in score)
Hearing Aid Experience	3.75 (years)

Subject 19



Group	Contract
Compliance	16 (sessions completed)
QSIN Difference	-1 (improvement in SNR loss)
HHIE Difference	-20 (improvement in score)
Hearing Aid Experience	4.92 (years)

Figure 5. Individual subject performance, audiometric data, and demographic data of participants who demonstrated the largest improvements in HHIE score and QSIN threshold from pre- to post-treatment. Negative differences indicate an improvement in performance from pre-treatment to post-treatment, and positive differences indicate a decrease in performance from pre-treatment to post-treatment.

Chapter 4: Discussion

The present study investigated if implementation of a signed contract stating commitment to completion of the LACE program would result in higher compliance rates relative to that of a control group. The present study also investigated subjective and objective treatment outcomes after completion of the LACE program and their relation to patient compliance rates. The no contract group demonstrated a compliance rate of 70% of subjects who completed all 20 of the LACE training sessions. In contrast, the contract group demonstrated a compliance rate of 50% of subjects who completed all 20 of the LACE training sessions. These results suggest that implementing a signed commitment form does not result in an increase in compliance rates. Two subjects that were members of the contract group, however, completed very few LACE sessions (Subject 15 and Subject 17, completing 4 and 2 sessions, respectively). Following exclusion of Subjects 15 and 17 from the contract group from the data, the average number of LACE sessions completed across groups increased substantially for the contract group (17/20 up from 14.2/20). The improvement in the average number of LACE sessions completed by subjects in the contract group after exclusion of subjects that completed the least amount of sessions suggests that the compliance rate data for this group was clearly skewed by these two subjects. All of the contract group subjects, with the exception of the two excluded subjects, completed at least ten of the 20 LACE sessions. However, the no contract group had three subjects that completed less than ten LACE sessions. While

implementation of a signed contract does not demonstrate a significant increase in compliance rates when compared to the no contract group, it appears to encourage subject completion of at least half of the entire LACE program. It may be argued that subjects who are fully compliant would always be compliant, regardless of a signed contract, perhaps due to personal motivation and personality traits. Clinic patient populations as a whole may receive greater benefit from the LACE program with implementation of a signed contract, as those who do not have the natural motivation to be fully compliant may be encouraged by signing a contract to complete more of the LACE program (at least ten sessions) than they would without the contract.

Kingham (2010) reported great success in increasing patient compliance with the LACE from utilization of a commitment form. Kingham (2010) reported a compliance rate of 50% after implementing the commitment form, which was an increase from the reported mean compliance rate of the LACE of less than 30%, reported by Sweetow (2009). Compliance rates reported by Sweetow (2009) reflect the percentage of LACE program users who complete at least ten of the 20 LACE sessions. Compliance rates reported by Kingham (2010) and in the present study reflect a more rigid definition of compliance, and reflect the percentage of participants who completed all 20 LACE sessions. The compliance rate in the present study for contract subjects that reflects completion of at least ten of the 20 LACE sessions was 80%. Kingham (2010) reported that 86% of patients that signed a commitment form completed at least part or all of the LACE program. While the compliance rate for subjects in the contract group from the present study was not significantly higher than the compliance rate for subjects in the no contract group, it is, like Kingham's (2010) data, higher than the reported compliance rate

from Sweetow (2009). The results from the present study support the results of Kingham (2010), indicating that implementation of a signed contract increases patient compliance of completing at least ten LACE sessions.

The present study revealed three subjects in the HHIE data (see Figure 3) that represented the largest improvement in hearing handicap from pre- to post-treatment. Six subjects from the QSIN data (see Figure 4) represented the largest improvements in QSIN threshold from pre- to post-treatment. As more subjects demonstrated large improvements in QSIN threshold than the number of subjects who demonstrated large improvements in HHIE score, it is suggested that individuals that complete at least part of the LACE program may show improvement in listening tasks before they subjectively identify improvement in personal hearing handicap. Several subjects in the present study also expressed surprise when the examiner shared results that revealed improvement in QSIN threshold from pre- to post-treatment. For clinical patient populations, focusing on each individual's specific results from pre- to post-treatment may actually encourage more confidence in listening skills and subsequently improve perception of hearing handicap. This patient-centered counseling alongside use of the LACE program may also encourage motivation to complete the entire program for potentially greater benefit if the patient has not been fully compliant.

Consideration of the compliance rates and demographic data of the subjects that demonstrated the largest improvements in outcome measures from pre- to post-treatment also indicated some interesting trends. Only one of the three subjects with the largest improvements in hearing handicap was a subject that was fully compliant with the LACE program, completing all 20 sessions in the allotted amount of time. Of the subjects with

the largest improvements in SNR loss from the QSIN data, five of the six completed all 20 LACE sessions. This trend suggests that subjects that are fully compliant with the LACE program and complete all 20 sessions in approximately 4-5 weeks are more likely to improve their QSIN performance from pre-treatment to post-treatment than their HHIE score. Only two of the subjects demonstrating the largest improvements in outcome measures from pre- to post-treatment had hearing aid experience levels that were above the overall subject average of 6.7 years. This trend suggests that individuals who complete the LACE program shortly after their initial amplification fitting date may experience greater improvement in outcome measures from pre- to post-treatment than individuals who complete LACE many years after their initial amplification fitting date. These findings therefore support implementation of an aural rehabilitation program at or shortly after the patient's initial hearing aid fitting as a practical clinical treatment philosophy in audiology.

An interesting subject in the present study was Subject 15, who was the only participant to show one of the largest improvements in both HHIE score (see Figure 3) and in QSIN threshold (see Figure 4) from pre- to post-treatment. Subject 15 also had the lowest compliance rate of the eight subjects that demonstrated the largest improvement in outcome measures, completing only four of 20 sessions. Bilateral air conduction pure tone thresholds were considered for subjects in the present study with the largest improvements in outcome measures following the LACE. It was revealed that Subject 15 has a better ear (left) pure tone average (PTA) of 8 dB HL, which was much lower than the other subjects' better ear PTA. Arkebauer, Mencher, and McCall (1971) tested subjects with bilateral asymmetrical hearing loss for differences in speech discrimination

scores under various listening conditions. Results from the Arkebauer et al. study (1971) suggested that speech discrimination scores are higher for subjects with a greater difference in hearing sensitivity and audiological configuration between ears than when the asymmetry approximates symmetry. As can be seen in Figure 5, Subject 15's asymmetrical hearing loss reflects a large difference between ears in both hearing sensitivity and audiological configuration, as the high frequency hearing loss slope for the right ear begins at 500 Hz while the slope for the left ear does not begin until 2000 Hz. Therefore, the nature of Subject 15's asymmetrical hearing loss along with his better left ear PTA may have resulted in a large improvement in both treatment outcome measurements following completion of only part of the LACE program.

Several subjects in the present study made comments to the examiner concerning the program itself, the signed contract, and the program's impact on understanding speech in noise in everyday life. Two subjects specifically spoke to positive impacts the signed contract and the LACE program had on their listening performance in noisy situations. Subject 7 demonstrated one of the largest improvements in outcome measure data from pre- to post-treatment, and commented that,

"Signing the contract made me more self-disciplined in completing each week's scheduled sessions".

Subject 7 was fully compliant, completing all 20 sessions of the LACE, and also had one of the largest improvements in QSIN threshold from pre-treatment to post-treatment. Subject 6 did not have large improvements in outcome measures from pre-treatment to post-treatment, but was fully compliant. Subject 6 reported,

"I returned to a lunch group that meets in a noisy restaurant that I had previously avoided because it was so hard to understand speech there. I wanted to see if using the LACE would make this lunch group an

enjoyable experience for me again, and it did! I noticed that I was able to understand speech much better by using some of the skills that I learned in LACE.”

While Subject 6’s outcome measurements did not reflect improvement in understanding speech in noise from pre- to post-treatment, completion of the LACE program provided this subject the confidence to attend a social activity that she had been missing due to her hearing impairment, and to successfully understand speech in a difficult listening situation. Feedback such as that received from Subject 6 and Subject 7 suggests that implementation of an aural rehabilitation program such as the LACE and an associated signed contract agreeing to completion of the program may result in both an improvement in understanding speech in noise, reflected in either outcome measure, and subject improvements in quality of life.

Chapter 5: Conclusion

The present study investigated the effect on subject compliance of the LACE program from implementation of a signed contract. Analysis of results revealed that an important factor in determining the effect of a signed contract on compliance with the LACE program was the compliance criterion itself. The compliance criterion of the present study was strict, in that a subject was only considered to be compliant if full completion of all 20 LACE sessions was accomplished within the allotted time frame of approximately five weeks. The compliance criterion used by the creator of the LACE program, however, was loose, in that a subject was considered to be compliant if at least ten of the 20 LACE sessions were completed (Sweetow, 2009). This difference in compliance criterion is a substantial factor in whether the LACE program or use of a signed contract are considered successful. The fact that the creator of the LACE program (Sweetow, 2009) uses a 50% completion criterion as a measure of success clearly demonstrates the challenges associated with adult rehabilitation and training.

Eliciting patient compliance to treatment is not only a challenge in audiology, but also in other healthcare fields. Haynes et al. (2002) report that patient compliance rates for medication prescriptions are typically approximately 50%, with even lower compliance rates for prescribed lifestyle and behavior regimens. Compliance rates in other healthcare fields besides audiology can also change according to the compliance criterion used, such as demonstrated in the present study. Patient compliance to

treatment for retinoblastoma was found to be only 47.5% when the compliance criterion was defined as completing enough treatment to achieve “effective therapy” (Bakhshi et al., 2010). However, when the compliance criterion was defined as completing enough retinoblastoma treatment to achieve “adequate therapy”, the patient compliance rate increased to 59.6% (Bakhshi et al., 2010). Olthoff et al. (2005) report that noncompliance rates for ocular hypotensive treatment across multiple studies range from 4.6% to 80%, depending on varying definitions of noncompliance, with stricter compliance criterion generally resulting in larger noncompliance rates.

There are advantages and disadvantages for both strict and loose compliance criterion philosophies. Use of a strict compliance criterion encourages full completion of all 20 LACE sessions, resulting in a greater potential for improvement in listening and communication skills from exposure to every task included in the LACE protocol. However, loose compliance criterion reveals higher compliance rates than those of strict compliance criterion, and therefore represents a larger number of individuals who may be described as having a successful experience with the LACE program. Having success with the LACE program is not clearly defined, as it may be considered to be completion of the entire program, completion of part of the program or enough of the program to yield improvement in outcome measures, or an increase in quality of life following any amount of exposure to the program. Appropriate compliance criterion may be different according the individual and his or her personal goals in aural rehabilitation.

Use of a signed contract has a different effect on subject compliance rates depending on the compliance criterion used. Use of strict compliance criterion in the present study suggested that implementation of a signed contract had no effect on

improving compliance rates. However, use of the Sweetow (2009) loose criterion suggested that implementation of a signed contract actually increased compliance rates when compared to the compliance rates of the no contract group, and these results suggest that a signed contract encourages completion of at least ten of the 20 LACE sessions. As subjects in the no contract group either completed 20 out of 20 LACE sessions or less than ten LACE sessions, use of a signed contract may result in subjects ultimately reaching a greater potential for improvement in listening and communication skills from exposure to the majority of the tasks included in the LACE protocol.

Benefit from the LACE program was measured in the present study by the HHIE and the QSIN, specifically because these outcome measures were used in the original development of the LACE (Sweetow & Henderson-Sabes, 2006). There were no significant differences present between outcome measure data from pre-treatment to post-treatment in the present study. However, many subjects had little room for improvement, as their HHIE scores and QSIN threshold were low to begin with. The HHIE and QSIN may be limited in measuring user benefit gained from the LACE, as these outcome measures may be too easy of a task, especially for subjects with many years of hearing aid experience. Use of more difficult outcome measures may have demonstrated greater benefit from the LACE. A task such as the speech perception in noise test (SPIN; Kalikow, Stevens, & Elliott, 1977), which considers perception of both low- and high-predictability items according to context in background babble, may be sensitive enough to reveal subtle benefit received from participation in the LACE program.

Future research should consider determining compliance criterion of the LACE on an individual basis, and using more difficult outcome measures such as the SPIN test.

Signed contracts completed with subjects before beginning the LACE may be helpful to use in setting individual goals for listening and communication skills, as well as in developing a schedule for completion of at least the majority of the LACE program and subsequently encouraging compliance. Additional methods that establish concordance and develop individualized patient motivation to complete recommended training in aural rehabilitation programs, such as the LACE, should be considered both clinically and in future research.

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Appendix A: LACE Contract Completed by the Contract Subject Group

LACE Contract

The purpose of this contract is to plan specific deadlines for reaching milestones within the LACE program. The subject and the examiner will agree upon appropriate and realistic deadlines together. Signatures from both the subject and the examiner will represent a commitment to complete the LACE program according to the schedule below:

Start the LACE program by:_____

Finish session 5 by:_____

Finish session 10 by:_____

Finish session 15 by:_____

Finish session 20 by:_____

Subject Name (signature)

Date

Subject Name (printed)

Examiner (signature)